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[4918]-302

T.Y. B.Sc. (III Sem.) EXAMINATION, 2016

COMPUTER SCIENCE

Paper II

CS-332 : Theoretical Computer Science

(2013 PATTERN)

Time : Two Hours

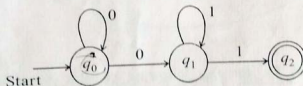
Maximum Marks : 40

- N.B. :— (i) Neat diagrams must be drawn wherever necessary.
 (ii) Figures to the right indicate full marks.
 (iii) All questions carry equal marks.
 (iv) All questions are compulsory.

1. Attempt all of the following :

[10×1=10]

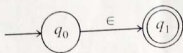
- (a) What are the proper prefixes and proper suffixes of the string "India" ?
 (b) Define left linear and right linear grammar.
 (c) Write the regular expression for the following FA :



$$\begin{aligned}
 RE &= q_0 = 0^* \\
 RE &= q_1 = 0^* 0 1^* \\
 RE &= q_2 = 0^* 0 1^* \\
 &= 0^* + 0^* 0 1^* + 0^* 0 1^*
 \end{aligned}$$

- (d) Compare λ' function of Melay and Moore machine.

- Write down the ' ϵ -closure' of each state from the following FA :

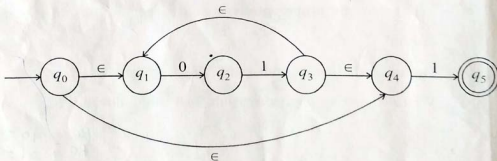


- (f) State the two different ways to simplify the CFG.
- (g) State the machines used for context free grammar and context-sensitive grammar.
- (h) Differentiate between PDA and FA.
- (i) Define tuples of LBA.
- (j) State pumping lemma of regular set.

2. Attempt any *two* of the following :

[2×5=10]

- (a) Construct a DFA to accept all decimal numbers divisible by 3.
- (b) Construct DFA equivalent to the following NFA :



- (c) Construct FA for the following regular expression :

$$(010 + 00)^* (10)^*$$

3. Attempt any *two* of the following :

[2×5=10]

(a) Define PDA and construct PDA for $L = \{a^n b^m a^n \mid m, n \geq 1\}$.

(b) Construct the following CFG into Chomsky Normal Form (CNF) :

$$S \rightarrow ABA$$

$$A \rightarrow aA \mid \epsilon \text{ (epsilon)}$$

$$B \rightarrow bB \mid \epsilon \text{ (epsilon)}$$

(c) Construct CFG for the following :

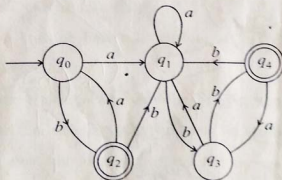
(i) $L = \{a^x b^y c^{x+y} \mid x, y \geq 1\}$

(ii) A language containing string having at least one occurrence of '00' over $\{0, 1\}$.

4. Attempt (A) or (B) :

(A) (a) Minimize the following DFA :

[4]



(b) Explain the types of Turing Machine (TM). [4]

(c) Explain any *one* closure property of regular set. [2]

Or

(B) (a) Construct TM for $L = \{ww^R \mid w \in (0 + 1)^*\}$. [4]

(b) Convert the following CFG into PDA : [4]

$$S \rightarrow 1S \mid 1S0S \mid 1$$

Also show that the string "11101" is accepted by the PDA.

(c) Define the terms :

(i) Ambiguous grammar

(ii) Parse tree.

[2]

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Admission

New Arts Commerce and Science
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State of Maharashtra.

Total No. of Questions—4]

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[4818]-302**T.Y. B.Sc. (C.S.) (Third Semester) EXAMINATION, 2015****COMPUTER SCIENCE****CS-332 : Theoretical Computer Science****(2013 PATTERN)****Time : Two Hours****Maximum Marks : 40****N.B. :—** (i) Neat diagrams must be drawn wherever necessary.

(ii) Figures to the right indicate full marks.

(iii) All questions carry equal marks.

(iv) All questions are compulsory.

1. Attempt all of the following :**[10×1=10]**

(a) Define null string.

(b) Write smallest possible string from the following regular expression.

$$(a + b) (aa)^* (ab)$$

(c) Define ambiguous grammar.

(d) DFA has an E-transition. State True or False.

P.T.O.

- (e) Describe the language for the following regular expression :

$$(00 + 11) (0 + 1)^* (00 + 11)$$

- (f) Define nullable symbol and useless symbol.

- (g) Define Type-2 grammar.

- (h) Distinguish between TM and FA.

- (i) Define ID of PDA.

- (j) Define non-deterministic TM.

2. Attempt any *two* of the following : [2×5=10]

- (a) Construct DFA to accept substring '101' or '001'.

- (b) Construct Moore machine and Mealy machine which outputs even or odd according to number of b 's encountered are even or odd over $\Sigma = \{a, b\}$.

- (c) Construct FA for the following regular expression.

$$a(a + b)^* b + b(b + a)^* a$$

3. Attempt any *two* of the following : [2×5=10]

- (a) Construct TM for language :

$$L = \{a^m b^n c^m \mid m, n \geq 0\}$$

- (b) Construct NPDA for a language :

$$L = \{\omega\omega^R \mid \omega \in (0 + 1)^*\}$$

- (c) Define Greibach Normal Form (GNF). Convert the following grammar into GNF :

$$A_1, S \rightarrow ABA \mid AB \mid BA \mid AA \mid A \mid B$$

$$A_2, A \rightarrow aA \mid a$$

$$A_3, B \rightarrow bB \mid b$$

4. Attempt A or B : [10]

- (A) (a) Show that the regular sets are closed under complementation. [4]

- (b) Minimize the following DFA : [4]

		Σ	
		a	b
Q			
Start	q_1	q_2	q_3
	q_2	q_3	q_3
	q_3	q_4	q_3
	q_4	q_3	q_5
*	q_5	q_2	q_5

where $M = (\{q_1, \dots, q_5\}, \{a, b\}, \delta, q_1, \{q_5\})$

- (c) Explain types of regular grammar. [2]

Or

- (B) (a) Construct a PDA which accepts a language : [4]

$$L = \{a^n b^{2n} \mid n \geq 1\}$$

- (b) Construct CFG for the following : [4]

(i) $L = \{a^n b^m c^n \mid n > 1, m > 0\}$

(ii) $L = L_1 \cap L_2$

where $L_1 = \{a^n b a^n \mid n \geq 1\}$

$$L_2 = \text{all strings having odd length over } \{a, b\}$$

- (c) State the differences between recursive and recursive enumerable language. [2]

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T.Y. B.Sc. (Semester III) EXAMINATION, 2017

COMPUTER SCIENCE

Paper II

CS-332 : Theoretical Computer Science (TCS)

(2013 PATTERN)

Time : Two Hours

Maximum Marks : 40

N.B. :- (i) All questions are compulsory.

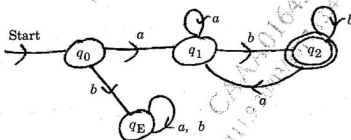
(ii) All questions carry equal marks.

(iii) Figures to the right indicate full marks.

1. Attempt all of the following :

[10×1=10]

- Define regular expression.
- Give the mapping of 'δ' function of NFA with ϵ moves.
- If $A = \{\epsilon\}$. Find the value of $|A|$.
- Which tool is used to prove that the language is not regular ?
- Differentiate between Moore and Mealy machine.
- Give the language accepted by the following FA :



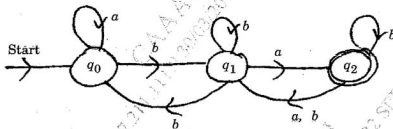
P.T.O.

- (g) Define Kleene Closure.
- (h) Write the tuples of Turing Machine.
- (i) Define ID for PDA.
- (j) Write a language for CFG :

$$S \rightarrow aSa | bSb | a | b | \epsilon.$$

2. Attempt any two of the following : [2×5=10]

- (a) Construct a DFA to accept the set of all strings over $\Sigma = \{0, 1, 2\}$ such that the string ends with '012' or '20'.
- (b) Construct a FA for the given RE : $(a^*b + b^*a).ab + ba.b^*$.
- (c) Convert the following given NFA to DFA :



3. Attempt any two of the following : [2×5=10]

- (a) (i) Construct CFG for language $L = \{a^n b^m c^m d^n \mid n \geq 1, m \geq 1\}$.
- (ii) Construct CFG for language L which accepts set of all palindromes over $\Sigma = \{a, b\}$.

- (b) Rewrite the following CFG after eliminating useless symbols :

$S \rightarrow 0A0$

$A \rightarrow S11CC1D0A$

$C \rightarrow 0111DD$

$E \rightarrow 0C$

$D \rightarrow 0DA$

- (c) Construct a TM for $L = \{wcw^R | w \in (a + b)^*\}$.

4. (A) Attempt any two of the following : [2×5=10]

(a) Construct a Moore machine for a language L over $\Sigma = \{0, 1\}$ which outputs '\$' if string ends with '100', outputs '#' if string ends with '001', otherwise outputs 'ε'.

(b) Construct a PDA for $L = \{0^m 1^n 2^n 0^m | m \geq 1, n \geq 1\}$.

(c) (i) Define Recursive language.

(ii) Differentiate between recursive and recursively enumerable languages.

Or

- (B) Attempt any two of the following : [2×5=10]

(a) Convert the following grammar to GNF :

$S \rightarrow AB1B$

$A \rightarrow BS$

$B \rightarrow A11$

(b) Construct PDA equivalent to the given CFG :

$$S \rightarrow aAb|aS$$

$$A \rightarrow Bb|a$$

$$B \rightarrow Sa|b$$

(c) Minimize the following DFA :

$$M = (q_0, q_1, q_2, q_3, q_4, q_5, q_6, q_7), \{0, 1\}, \delta, q_0, \{q_1\})$$

where δ is given by :

δ	0	1
$\rightarrow q_0$	q_4	q_0
$*q_1$	q_1	q_0
q_2	q_1	q_3
q_3	q_7	q_2
q_4	q_0	q_5
q_5	q_1	q_4
q_6	q_7	q_1
q_7	q_3	q_7

Total No. of Questions—4]

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[5018]-302

T.Y. B.Sc. (III Semester) EXAMINATION, 2016

COMPUTER SCIENCE

Paper II

[CS-332 : Theoretical Computer Science (TCS)]

(2013 PATTERN)

Time : Two Hours

Maximum Marks : 40

N.B. :— (i) *All questions are compulsory.*

(ii) *All questions carry equal marks.*

(iii) *Figures to the right indicate full marks.*

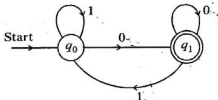
1. Attempt all of the following :

[10×1=10]

- (a) State True or False. Is a^*b^* equal to $(ab)^*$.
- (b) Define NFA.
- (c) Define proper suffix with the help of an example.
- (d) Write the mapping of λ function in Mealy Machine.
- (e) Give any *two* identities of regular expression.
- (f) Define Multitape Turing Machine.
- (g) State the machines used for CSG and CFG.
- (h) Define ambiguous grammar.

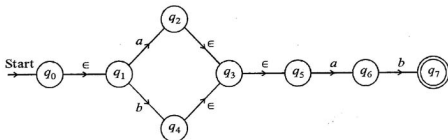
P.T.O.

- (i) Why is PDA more powerful than FA ?
- (j) Give the regular expression for the following DFA.



2. Attempt any *two* of the following : [2×5=10]

- (a) Construct a DFA to accept the set of all strings over $\Sigma = \{a, b, c\}$ such that the string starts with 'ac' and not having 'cab' as a substring in it.
- (b) Construct a NFA with ϵ moves for the given RE : $01(0+1)^* + 1^*0^*$.
- (c) Convert the following NFA with ϵ moves to DFA.



3. Attempt any two of the following : [2×5=10]

(a) (i) Construct CFG for language $L = \{a^n b^n c^m d^r \mid m, n, r \geq 1\}$.

(ii) Define Type-2 Grammar.

(b) Rewrite the following CFG after eliminating ϵ productions :

$S \rightarrow AB \mid aBb$

$A \rightarrow aA \mid \epsilon$

$B \rightarrow AD \mid aAb$

$D \rightarrow bD \mid \epsilon$

(c) Construct a PDA for $L = \{a^m b^n c^{n+1} d^m \mid n \geq 1, m \geq 1\}$.

4. (A) Attempt any two of the following : [2×5=10]

(a) Construct a Mealy machine for a language L over $\Sigma = \{0, 1\}$ which outputs '\$' if string ends with 'aba', outputs '#' if string ends with 'bab', otherwise outputs ' '.

(b) Construct a TM for a language L , where $L = \{a^{m+n} b^m c^n \mid m, n \geq 1\}$.

(c) (i) Differentiate between DFA and NFA.

(ii) Differentiate between TM and LBA.

Or

(B) Attempt any two of the following : [2×5=10]

(a) Convert the following grammar to GNF :

$S \rightarrow AA \mid a$

$A \rightarrow SS \mid b$

(b) Construct PDA equivalent to the given CFG :

$$S \rightarrow AA$$

$$A \rightarrow 0A0 \mid A1 \mid 1$$

(c) Minimize the following DFA :

$M = (\{q_0, q_1, q_2, q_3, q_4\}, \{0, 1\}, \delta, q_0, \{q_2, q_4\})$ where

δ is given by :

δ	0	1
$\rightarrow q_0$	q_1	q_2
q_1	q_1	q_3
$* q_2$	q_0	q_1
q_3	q_1	q_4
$* q_4$	q_3	q_1